

NERRS Science Collaborative Progress Report for the Period 3/1/2011 through 8/31/2011

Project Title: A collaborative approach to address larval supplies and settlement as critical early life-history issues during restoration of native Olympia oysters (*Ostrea lurida*) in Coos Bay and the South Slough estuary

Principal Investigator(s): Dr. Steven Rumrill

Project start date: Nov 2010

Report compiled by: Steven Rumrill / John Bragg

Contributing team members and their role in the project:

Integration Leader: Frank Burris, Extension Watershed Educator
Oregon State University Extension Service
Gold Beach, OR
Role in project: Facilitation of interactions between the stakeholders (Olympia Oyster Restoration Advisory Committee) and project team members. Mr. Burris has expertise with community stakeholder discussions in rural environments, and will provide for integration and leadership through the joint fact-finding / structured decision-making process.

Co-Principal Investigators: Dr. Craig Young, Professor of Biology
University of Oregon / Oregon Institute of Marine Biology
Charleston, OR
Role in project: Director of OIMB and collaborating project scientist with particular expertise in the reproductive biology and larval ecology of marine and estuarine invertebrates. Dr. Young will serve as the primary graduate thesis advisor for one graduate student (module 1 / reproduction and reproductive output) supported by the project.

Dr. Alan Shanks, Professor of Biology
University of Oregon / Oregon Institute of Marine Biology
Charleston, OR
Role in project: Collaborating project scientist with particular expertise in larval behavior, dispersal, and tidally-driven transport in estuaries. Dr. Shanks will serve as the primary graduate thesis advisor for one graduate student (module 2 / larval supplies and dispersal) supported by the project.

Dr. Richard Emlet, Professor of Biology
University of Oregon / Oregon Institute of Marine Biology
Charleston, OR
Role in project: Collaborating project scientist with particular expertise in larval development, hydromechanics, larval settlement, and metamorphosis. Dr. Emlet will serve as the

primary graduate thesis advisor for one graduate student (module 3 / larval settlement and metamorphosis) supported by the project.

Jamie Doyle, Marine Community Development Leader
Oregon Sea Grant Extension Program (Coos County)
Myrtle Point, OR

Role in project: Work with project team to develop a series of presentations, fact sheets, briefing materials to ensure that the stakeholders and scientists share a common level of understanding about the biology and ecology of Olympia oysters. Ms. Doyle has expertise with marine resource policy and management, community education, and outreach, and she will provide assistance to the Integration Leader with the SDM process.

John Bragg, Communications Leader
Coastal Training Program Coordinator
South Slough National Estuarine Research Reserve
Charleston, OR

Role in project: Work to conduct regular and routine communications among members of the project team and the NERRS Science Collaborative, to compile and summarize discussion notes generated during OORAC meetings, serve as co-author of the NSC Biannual reports, and assist with development of presentations, fact sheets, and briefing materials. Mr. Bragg has expertise with condensation of technical research materials into summary sheets, and will provide an interface for the project with the South Slough National Estuarine Research Reserve. John will also provide assistance to the Integration Leader with the SDM process.

- A. Progress overview: State the overall goal of your project, and briefly summarize in one or two paragraphs, what you planned to accomplish during this period and your progress on tasks for this reporting period. This overview will be made public for all reports, including confidential submissions.

Project Goal: The overall goal of this project is to investigate the importance of reproductive timing and output, larval supplies, estuarine retention time, settlement, and recruitment as factors that potentially limit recovery of self-sustaining populations of *Ostrea lurida* in Coos Bay and the South Slough estuary. Our specific objectives are to: (A) bring together a diverse group of stakeholders and user-groups to form an Olympia Oyster Recovery Advisory Committee (OORAC); (B) determine the suite of intrinsic ecological, reproductive, and early life-history factors that contribute to the success of Olympia oyster restoration efforts in Coos Bay/South Slough; and (C) integrate the perspectives and collective knowledge from resource agencies, academic investigators, mariculture operators, restoration practitioners, and recreational stakeholders during development of an Olympia Oyster Conservation and Recovery Strategy for Coos Bay.

Accomplishments: The recruitment process was completed over the spring of 2011 for three new graduate students who joined the University of Oregon – Oregon Institute of Marine Biology

to conduct their MSC thesis research on the reproductive biology and larval ecology of native Olympia oysters. The three new graduate students will work in a collaborative manner with the members of the Olympia Oyster Recovery Advisory Committee to incorporate traditional knowledge, stakeholder perspectives, and technical information into their original scientific research focused on module 1 (oyster reproduction and reproductive output), module 2 (larval supplies and dispersal), and module 3 (larval settlement and metamorphosis). Mark Oates (BSc University of Miami) joined the project team in June 2011 from his home in Florida, and he will work under the direction of Dr. Craig Young to conduct thesis work that focuses on oyster reproduction and reproductive output. Rose Rimler (BSc University of California - Berkeley) joined the project team in August 2011 from her home in California, and she will work under the direction of Dr. Richard Emlet to conduct thesis work that focuses on the larval settlement and metamorphosis of Olympia oysters. Catherine Pritchard will join the project team in mid-September 2011 from her home in Florida, and she will work under the direction of Dr. Alan Shanks to conduct thesis work that focuses on the dispersal and retention of Olympia oyster larvae in the Coos Bay tidal basin.

The PI (Steve Rumrill), Integration Leader (Frank Burris), and Communications Leader (John Bragg) worked together in July and August to finalize the purpose and membership of the Olympia Oyster Recovery Advisory Committee (OORAC). The primary role of OORAC will be to provide diverse input in the form of stakeholder perspectives, practical knowledge, technical expertise, and management alternatives during development of the Olympia Oyster Conservation and Recovery Strategy for Coos Bay. The OORAC will be guided by a Structured Decision-Making process that will incorporate stakeholders and intended users directly into a series of research projects conducted by local scientists and graduate students at the Oregon Institute of Marine Biology. A collaborative process will be followed to ensure that stakeholders and local scientists work together to define the problems, identify data gaps, conduct the necessary research, and to develop a practical strategy to assist with the conservation and recovery of Olympia oyster populations. The OORAC will meet with the project team and graduate students on a quarterly basis to receive project updates, provide feedback, and to make critical decisions regarding advancement of the research. New information generated by the students will be coupled with existing data and traditional knowledge that surfaces during the OORAC discussions to gain a more complete understanding of the factors that influence recovery of Olympia oyster populations in Coos Bay. The membership of the OORAC is provided in Appendix A (below).

Members of the science team (S. Rumrill, C. Young) took steps over July and August 2011 to provide the first new graduate student (M. Oates) with: (A) an overview of the NERRS Science Collaborative approach to engagement with stakeholders; (B) a description of the NSC Olympia oyster project; (C) a summary of the techniques that will be used to characterize changes in the reproductive status of adult oysters; and (D) an orientation to the study sites that will be used for the collection and sampling procedures for module 1 (reproduction and reproductive output). A series of oyster cultch bags were collected from beneath a floating dock operated by one of the project stakeholders (Sause Brothers Ocean Towing) where they had been deployed over the past year as settlement surfaces for recruitment of Olympia oyster larvae and early juveniles, and a series of new cultch bags were deployed that will serve as settlement sites and a source of early juveniles for research activities undertaken in the spring and summer of 2012 (module 3 (larval settlement)). A sub-set of the science team (S. Rumrill, R. Emlet) met with the second new graduate student (R. Rimler) in August 2011 to describe the NERRS Science Collaborative approach, provide a description of the NSC Olympia oyster project, and to begin the discussion about techniques, equipment, and protocols that may be used to investigate the settlement and metamorphosis of Olympia oyster larvae (module 3). S. Rumrill also worked directly with an

intern (Joanne Choi; Oregon Sea Grant Summer Scholar Program) throughout the summer to design, construct, and deploy a series of twelve modular, artificial cement oyster habitat clusters. The OLY-ROCS (Olympia Oyster – Restoration of Oysters on Cement Substrata) consist of cement paving stones fitted with an upper layer of fragmented shell and clusters of intact adult oyster shells, and they were deployed into the lower intertidal zone of Haynes Inlet and Isthmus Slough to serve as heterogeneous benthic habitat, settlement sites, and a source of early juveniles for research activities undertaken in the spring and summer of 2012 (module 3 (larval settlement)).

The PI, Communications Leader (John Bragg), and intern (Joanne Choi) worked together in July and August to initiate development of a series of fact sheets about Olympia oysters that will be distributed, summarized, critiqued, and revised by the OORAC stakeholders. The fact sheets will be coupled with brief PowerPoint presentations delivered during the OORAC meetings to serve as focal points for the discussion and to bring the membership of OORAC to a common level of understanding regarding the biology, ecology, history, and management issues for Olympia oysters in Coos Bay.

B. Working with Intended Users:

- Describe the progress on tasks related to the integration of intended users into the project for this reporting period.
- What did you learn? Have there been any unanticipated challenges or opportunities?
- Who has been involved?
- Has interaction with intended users brought about any changes to your methods for integration of intended users, the intended users involved, or your project objectives?
- How do you anticipate working with intended users in the next six months?

The PI (Dr. Steve Rumrill) held a series of one-on-one meetings and discussions over the spring and summer with many of the project stakeholders and prospective members of the Olympia Oyster Recovery Advisory Committee. The discussions, meetings, and phone calls were specifically held to introduce the stakeholders to the NSC Olympia oyster project, to gain the stakeholder perspectives on priority issues that are related to the recovery of Olympia oyster populations, and to gauge their interest in participation as members of the OORAC. In particular, discussions were held with S. Groth, P. Baker, B. Dumbauld, J. Hampel, L. Clausen, L. Qualman, C. Sause, D. Ivy, J. Schaffer, G. Tinker, D. Van der Schaaf, K. Cellura, E. Clough, M. Giles, and L. Hoberecht, and the group shared their diverse opinions and perspectives about the priority issues, potential approaches toward development of the Olympia oyster conservation strategy, and about the NSC objective to achieve meaningful applications of science through a collaborative approach. All but one of the stakeholders indicated that they are willing to serve as a member of the OORAC, but they hold a diversity of opinions about the efficacy of large-group meetings versus smaller-group discussions.

What did we learn? Four important issues emerged during the series of discussions with stakeholders: (A) Potential effects of dredging a new pipeline for the delivery of Liquefied Natural Gas (LNG) on populations of Olympia oysters in Haynes Inlet; (B) Potential effects of ocean acidification on the survival and settlement of larvae from Pacific oysters and Olympia oysters; (C) Effects of *Vibrio tubiashii* bacteria on survival of oyster larvae and juveniles; and (D) Management regulations regarding the ownership and right-to-sales for adult Olympia oysters that have become attached to the living shells of cultured Pacific oysters. The local communities, Coos County Planning Department, and the state of Oregon Land Use Board of

Appeals have been actively engaged in debate regarding the scoping and feasibility studies for construction of a new LNG terminal located along the shoreline of Coos Bay at Jordan Cove. Unanswered questions about the potential impacts of dredging (associated with excavation and placement of the LNG pipeline), turbidity, and sedimentation on survival of populations of native Olympia oysters. In response to this concern, it may be possible within the scope of the NSC project to adapt the study plan to accommodate the request for new information, and to design and conduct an L:D-50 bioassay experiment to assess the tolerance and susceptibility of Olympia oyster larvae, post-larvae, and juveniles to exposure to different sediment loads and sedimentation treatments. The issue regarding the effects of ocean acidification on survival and growth of oysters in Coos Bay can be partially addressed by analysis of time-series datasets to characterize variability in ambient water quality parameters generated by the South Slough NERR / System-wide Monitoring Program (SWMP). More specifically, retrospective analysis of the NERR SWMP data indicate that pH values have increased within the estuarine waters of the South Slough over the period of 2002 to 2010 rather than decreased. Changes in estuarine pH values are indicative of shifts in net ecosystem metabolism, and increased alkalinity of the estuary may be an early indicator of increased photosynthetic activity and possible eutrophication. However, adequate time-series datasets and detailed measurements of pH, pCO₂, and TA values do not exist for the mesohaline waters where the majority of Pacific and Olympia oyster live within Coos Bay. The ocean acidification issue is currently being addressed for Netarts Bay and Yaquina Bay (Oregon) by a grant-supported project and multiple graduate students at Oregon State University (Dr. Chris Langdon, Molluscan Broodstock Program), but no new laboratory or field work is currently taking place in Coos Bay. Scientists at Oregon State University are also addressing the issue of contamination by *Vibrio* bacteria and their effect on survival of Pacific oyster larvae, but this microbial ecology issue is beyond the technical capabilities of the science team associated with the NSC Olympia oyster project. Finally, the regulatory/management issue regarding ownership of Olympia oysters that become attached to cultured pacific oysters is beyond the scope of this NSC project, but the science team will specifically collect highly relevant data to describe the extent of settlement by Olympia oysters on Pacific oyster shells to develop an estimate of by-catch and incidental mortality (module 3).

During the next six months, we will continue to hold direct discussions with members of the OORAC stakeholder group and hold the initial meeting of OORAC (establish purpose, member introductions and initial perceptions, problem definition, SDM process). By working across the multiple sectors of academia, state and federal resource agencies, commercial shellfish industry operators, restoration practitioners, and other stakeholders, we have gained recognition that it will be challenging, difficult, and rewarding to bring all of the members of OORAC into same place at the same time. Although the membership of OORAC is focused on individuals who work and reside in the immediate vicinity of Coos Bay, several members will contribute expertise from their positions well outside the bay area. It has been particularly difficult to identify a date for the OORAC meeting in the summer that does not present a conflict with other ongoing commitments and out-of-state travel. We are now conducting a doodle poll to establish the date in late October / early November to convene the members of the OORAC into the initial stakeholder group meeting. During the initial meeting the Integration Leader will query the members of OORAC to identify the preferred methods for meetings (large vs. small group) and communications.

C. Progress on project objectives for this reporting period:

- Describe progress on tasks related to project objectives for this reporting period.
- What data did you collect?

- Has your progress in this period brought about any changes to your methods, the integration of intended users, the intended users involved or the project objectives?
- Have there been any unanticipated challenges, opportunities, or lessons learned?
- What are your plans for meeting project objectives for the next six months?

Members of the science team completed the recruitment of three new graduate students (Mark Oates, Rose Rimler, Catherine Pritchard) who will join the Oregon Institute of Marine Biology to conduct their MSC thesis research on the reproductive biology and larval ecology of native Olympia oysters. The three new graduate students will work in a collaborative manner with the members of the Olympia Oyster Recovery Advisory Committee to incorporate traditional knowledge, stakeholder perspectives, and technical information into their original scientific research focused on module 1 (oyster reproduction and reproductive output), module 2 (larval supplies and dispersal), and module 3 (larval settlement and metamorphosis). We also continued to work on development of a localized conceptual model of the factors that control larval settlement and recruitment in populations of Olympia oysters, and to develop a series of one-page fact sheets to describe characteristics of the natural history and reproductive biology of the Olympia oysters. The membership of OORAC has been established (see Appendix A).

Several different types of data were collected by members of the science team over the spring and summer months. These datasets include: (A) time-series measurements of estuarine water quality parameters generated by the South Slough NERR System-wide Monitoring program (estuarine water temp, sal, cond, pH, DO, Chl-a, turb) at several locations along the estuarine gradient of the South Slough (S. Rumrill); (B) time-series measurements of estuarine water temperatures generated by Hobo TidBit dataloggers deployed at several locations in the mesohaline region of Coos Bay (A. Shanks / L. Garcia; OIMB); (C) monthly CTD casts within the primary tidal channel of Coos Bay (A. Shanks / L. Garcia; OIMB); (D) biweekly assessment of new Olympia oyster recruits to shells of pacific oysters deployed in Coos Bay (C. Young / K. Sawyer; OIMB); and (E) deployment of 60 bags of Pacific oyster shell to serve as settlement sites for recruitment of juvenile Olympia oysters in Coos Bay. In addition, we also designed, constructed, and deployed a series of twelve modular, artificial cement oyster habitat clusters (S. Rumrill / J. Choi; SSNERR) that will be recovered from the intertidal zone in the spring of 2012 to provide a source of early juvenile Olympia oysters.

Changes in methods: Stakeholder concerns were raised about the potential impacts of dredging (associated with excavation and placement of a Liquefied Natural Gas pipeline), turbidity, and sedimentation on survival of populations of native Olympia oysters. In response to this concern, we will adapt the study plan to accommodate the request for new information by designing an L:D-50 bioassay experiment to assess the tolerance and susceptibility of Olympia oyster larvae, post-larvae, and juveniles to exposure to different sediment loads and sedimentation treatments.

Unanticipated challenge: The communities of Coos Bay, North Bend, and Charleston continue to be actively engaged in public debate regarding the scoping and feasibility studies for construction of a new liquefied natural gas (LNG) terminal located along the shoreline of Coos Bay at Jordan Cove. Emergence of the LNG/Oyster issue as a pressing topic of local concern may require that the issue be addressed by the OORAC in the course of their discussions about recovery of Olympia oyster populations in Coos Bay. The Coos County Planning Department initially scheduled a hearing to gather testimony regarding the LNG/Oyster issue for June 2011, and the hearing was postponed until late

September 2011 to allow the LNG industry representative additional time to prepare their written materials and testimony.

During the next six months, the project team will hold a project planning meeting shortly after the arrival of the third new graduate students to establish the workplan for the fall (September 2011), conduct a doodle-poll to identify the date for the OORAC meeting, hold the initial meeting of OORAC (October/November 2011), conduct field collections and laboratory work to induce gravid adult oysters to spawn and release brooded larvae, determine culture techniques for the swimming oyster larvae, and prepare a series of fact sheets and presentations on the natural history and reproductive biology of Olympia oysters for presentation during the OORAC meetings (October 2011).

D. Benefit to NERRS and NOAA: List any project-related products, accomplishments, or discoveries that may be of interest to scientists or managers working on similar issues, your peers in the NERRS, or to NOAA. These may include, but are not limited to, workshops, trainings, or webinars; expert speakers; new publications; and new partnerships or key findings related to collaboration or applied science.

- Larval Settlement and OLY-ROCS (module 3): Members of the science team worked with a local stakeholder (Sause Brothers Ocean Towing) to recover a series of oyster shell cultch bags that were suspended in the water from a floating dock. Examination of the shells revealed that localized settlement of Olympia oyster larvae occurs in Coos Bay primarily in late summer and fall (peaks in August and October). In an effort to develop more realistic substrata for the assessment of larval settlement in the field, the science team designed, constructed, and deployed a series of 12 modular artificial cement oyster habitat clusters. OLY-ROCS (Olympia Oyster – Restoration of Oysters on Cement Substrata) consist of cement paving stones fitted with an upper layer of fragmented shell and clusters of intact adult oyster shells.

E. Describe any activities, products, accomplishments, or obstacles not addressed in other sections of this report that you feel are important for the Science Collaborative to know.

- Presentation about Olympia oysters during dedication of NOAA Marine Operations Center – Pacific: The South Slough NERR was invited by NOAA to participate during recent dedication ceremonies and an open-house to commemorate opening of the new NOAA Marine Operations Center – Pacific (MOC-C) in Newport (Oregon). The dedication ceremony and open-house event (20-21 August 20-21) was very well attended by the Governor, senators, senior NOAA administrators, local Port officials, and about 2,000 members of the public. South Slough NERR set up a booth during the open-house event, and the project team (M. Graybill / S. Rumrill / J. Bragg) presented information about the Coos Bay estuary and the ecology and recovery of Olympia oysters to a group of about 800 to 1,000 people.
- The Oregon Department of Fish and Wildlife / Marine Resources Program / Shellfish Program was identified in the original proposal as one of the primary intended users of work products generated by the project. As the leader of the statewide Oregon Shellfish Management Program, Dr. Leslee Parr was a key Intended User of the information generated by the project, and a letter of commitment written by Dr. Parr on behalf of the ODFW Shellfish Program was

included in the original project proposal. Dr. Parr has since resigned her position with the state natural resource agency to take on another responsibility in academia. In response to her resignation, ODFW initiated the agency recruitment process to identify, interview, and select a new candidate to fill this key leadership position. The ODFW search committee conducted a series of interviews with prospective candidates in mid June and August 2011, and the agency is currently in negotiations with the top-ranked candidate. In the meantime, Scott Groth (ODFW Shellfish Biologist) serves as the project representative of the Oregon Department of Fish and Wildlife / Shellfish Program.

Appendix A. Olympia Oyster Recovery Advisory Committee

Purpose: The primary role of the Olympia Oyster Recovery Advisory Committee will be to provide diverse input in the form of stakeholder perspectives, practical knowledge, technical expertise, and management alternatives during development of the Olympia Oyster Conservation and Recovery Strategy document for Coos Bay. The OORAC will be guided by a Structured Decision-Making process that will incorporate stakeholders and intended users directly into a series of new research projects conducted by local scientists and graduate students at the Oregon Institute of Marine Biology. The collaborative process will be followed to ensure that stakeholders and local scientists work together to define the problems, identify data gaps, conduct the necessary research, and revise the study plan in an adaptive manner to develop a practical strategy for the conservation and recovery of Olympia oysters in Coos Bay.

The OORAC will meet with the project team on a quarterly basis to receive project updates on the status of the research, provide feedback, and to make critical decisions regarding next steps for the restoration and enhancement of Olympia oysters within Coos Bay.

Project Team:

- Integration Leader: Frank Burris, Oregon State University Extension
- Communications Leader: John Bragg, South Slough National Estuarine Research Reserve
- Education/Outreach: Jamie Doyle, Oregon Sea Grant Extension
- Principal Investigator: Steve Rumrill, South Slough National Estuarine Research Reserve
- OIMB Graduate Students: Mark Oates, Rose Rimler, Catherine Pritchard
- OIMB Scientists: Craig Young, Alan Shanks, Richard Emlet
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OORAC Membership:

- A. Commercial Shellfish Mariculture Operators
 - Coos Bay Oyster Company (Jess Hampel)
 - Silver Point Oysters (Lili Clausen)
 - Qualman Oyster Company (Larry Qualman)
 - North Bend Oyster Company (Jerry Hampel)
 - Yaquina Bay Oysters (Xin Liu)*
 - Whiskey Creek Shellfish Hatchery (Sue Cudd)*
- B. Port and Harbor Districts
 - Oregon International Port of Coos Bay (Martin Callery)
 - Port of Yaquina Bay (Don Mann)*
- C. Natural Resource Agencies
 - Oregon Department of Fish and Wildlife / Shellfish Program (Scott Groth)
 - Oregon Department of Agriculture / Oyster Lease Program (Jim Johnson)*
 - Oregon Department of Land Conservation and Development (Andy Lanier)*
 - Oregon Department of Environmental Quality (Pamela Blake)
 - Oregon Department of State lands / South Slough National Estuarine Research Reserve (Mike Graybill)

- Oregon Department of Transportation (Julie Worsley)
 - US Army Corps of Engineers (Kate Groth)
 - NOAA National Marine Fisheries Service (Laura Hoberecht)*
 - US Dept of Agriculture / Agriculture Research Service (Brett Dumbauld)
- D. Native Oyster Restoration Practitioners
- NOAA Community-Based Restoration Program (Megan Callahan-Grant)*
 - The Nature Conservancy / Marine Program (Dick Van der Schaaf / Steve Denny)*
 - Puget Sound Restoration Fund (Betsy Peabody)*
- E. Local Tribes of Indigenous Peoples
- Coquille Tribe (Don Ivy, Tom Younker)
 - Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians (John Schaffer)
- F. Elected Officials
- Coos County Commissioner (Cam Parry)
 - Mayor of Coos Bay (Crystal Shoji / Jennifer Groth)
- G. Shoreline Industry
- Oregon Resources Corp (Pete Zagar / Kris McCaig)
 - Sause Brothers Ocean Towing (Cory Sause)
 - Southwest Oregon Regional Airport (Bob Hood)
- H. Public Stakeholders
- Coos Bay / recreational boaters (George Tinker)
 - Marshfield High School / science teacher (Kevin Cellura)
 - Resident of South Slough (Brent Lerwill)
 - Resident of Coos Bay / living shorelines (Rex Miller)
 - Resident of Coos Bay / birdwatchers (Eric Clough)
- I. Academic Investigators
- Oregon Institute of Marine Biology (Craig Young, Richard Emlet, Alan Shanks, Nora Terwilliger, Laura Garcia)
 - Oregon State University (Chris Langdon)
 - University of Washington (Alan Trimble)*
 - University of California – Davis (Ted Grosholz)*
 - University of Florida (Patrick Baker)*

Note: * denotes out-of-area members who will participate in critique and review of OORAC activities from a distance via email, conference calls, and correspondence.